MITSUBISHI HEAVY INDUSTRIES, LTD.

Mitsubishi Heavy Industries, Ltd.
Air-Conditioning & Refrigeration Systems Headquarters
16-5, Konan 2-chome, Minato-ku, Tokyo, 108-8215 Japan
**http://www.mhi.co.jp**

**ISO9001**
Our Air Conditioning & Refrigeration Systems Headquarters is an ISO9001 approved factory for residential air conditioners and commercial-use air conditioners (including heat pumps).

BIWAJIMA PLANT
Mitsubishi Heavy Industries, Ltd.
Air-conditioning & Refrigeration Systems Headquarters
Certified ISO 9001
Certificate number : JQA-0709

MITSUBISHI HEAVY INDUSTRIES-MAHAJAK AIR CONDITIONERS CO., LTD.
Certified ISO 9001
Certificate Number : 04100 1998 0813

**ISO14001**
Our Air Conditioning & Refrigeration Systems Headquarters has been assessed and found to comply with the requirements of ISO14001.

BIWAJIMA PLANT
Mitsubishi Heavy Industries, Ltd.
Air-conditioning & Refrigeration Systems Headquarters
Certified ISO 14001
Certificate number : JQA-EM0256

MITSUBISHI HEAVY INDUSTRIES-MAHAJAK AIR CONDITIONERS CO.,LTD.
Certificate Number : 04104 1998 0813 E5

**HB91-12HM01E-A-1** Jan. 2013(1B)R

Because of our policy of continuous improvement, we reserve right to make changes in all specifications without notice.
Printed in Japan

MITSUBISHI HEAVY INDUSTRIES, LTD.

Our Technologies, Your Tomorrow

# Eco·lution

## Commercial use Heat pump water heater

**Ecological energy**
**Recovering heat energy from the air**

**Q-ton** Air to Water

ESA30E

省エネ大賞

日本冷凍空調学会
技術賞

50 Hz

12HM01E-A-1

# Free energy from the air
# Overwhelming high performance and high efficiency

"Our technology, Your tomorrow"

## Q-ton Air to Water is born

Next-generation system developed with our combines responsibility to global environment

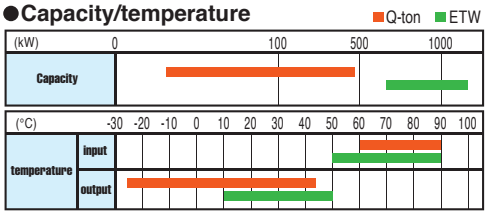
**The world's first**

$CO_2$ two-stage compressor with the combination of rotary and scroll compression cycles

**The most ecological way for supplying hot water**

**Our Heat Pump series**

●Capacity/temperature




Natural refrigerant $CO_2$
Air to Water System

30kW ~ 480kW (for commercial use)

Q-ton Air to Water

ESA30E

Water to Water System
Heat recovery type

627kW ~ 3135kW (for industrial use)

ETW

ecoTurbo

※Please refer to the other catalogue.

ESA 30-25

Q-ton (ESA 30-25 for the Japanese domestic market) received
The 2011 Fiscal Year grand prize
for Excellence in Energy Efficiency and Conservation
in Products Category & Business Model Category
from The Energy Conservation Center, Japan (ECCJ)
as attached.

Activities of ECCJ
1) Promotion of energy efficiency and conservation for the industry and commercial sectors
2) Providing information for further dissemination of energy-saving equipment
3) Providing information to encourage energy-saving lifestyle
4) Publishing and education
5) International cooperation
6) National examination for the qualified energy managers and the training
http://www.asiaeec-col.eccj.or.jp/index.html

日本冷凍空調学会
技 術 賞

ESA 30-25

Q-ton (ESA 30-25 for the Japanese domestic market)
received the Fiscal Year 2011 technology award
from Japan Society of Refrigerating and Air Conditioning
Engineers (JSRAE) as attached.

Activities of JSRAE
1) Survey, research, education and training, awards and certificate recognition for entitled engineers and scientists
2) Organization of annual JSRAE meeting, roundtable conferences, training short courses and workshops, technical visits and other events.
3) Publication of monthly journal "Reito"(refrigeration), Transactions of JSRAE and various books, textbooks, and handbooks.
4) Liaison with the International Institute of Refrigeration, IIR.
5) Implementation of correspondence education system.
6) Other miscellaneous†activities essential to fulfil the objectives.
http://www.jsrae.or.jp/jsrae/Eindex-2.html

## High Performance

**-25°C → 90°C**

Even in the extremely cold regions with outdoor temperature as low as -25°C, 90°C water supply is possible

**-7°C → 100%**

Keeping 100% capacity down to -7°C

## Ecology

**COP 4.3!**

The industry's highest COP level
COP4.3 (In intermediate season)

Natural refrigerant $CO_2$
Air to Water Heat Pump

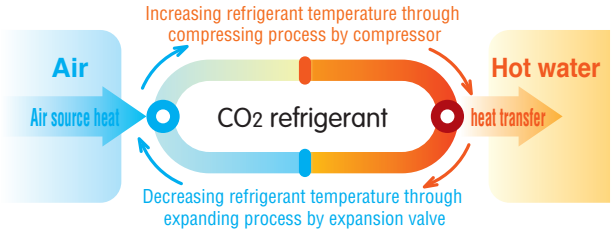

P04 Heat Pump Technology system
P06 Q-ton's unique advantages
P08 Hot water supply system
P10 Installation samples
P12 Specifications and dimensions
P14 Installation work

# Heat Pump technology system

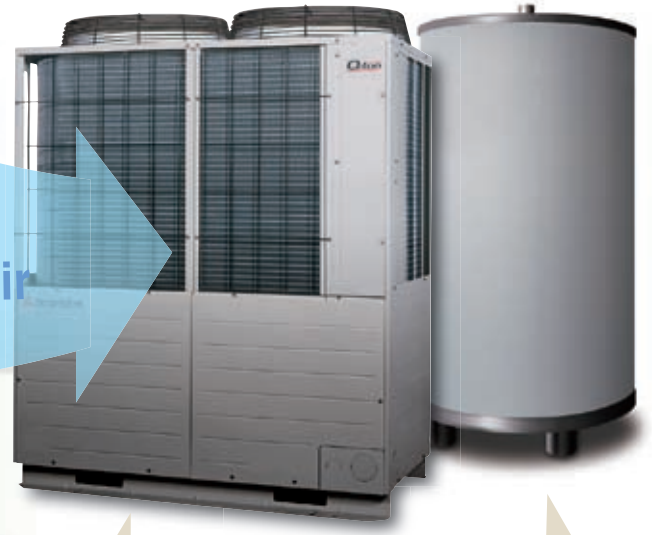
## What is a Heat Pump ?

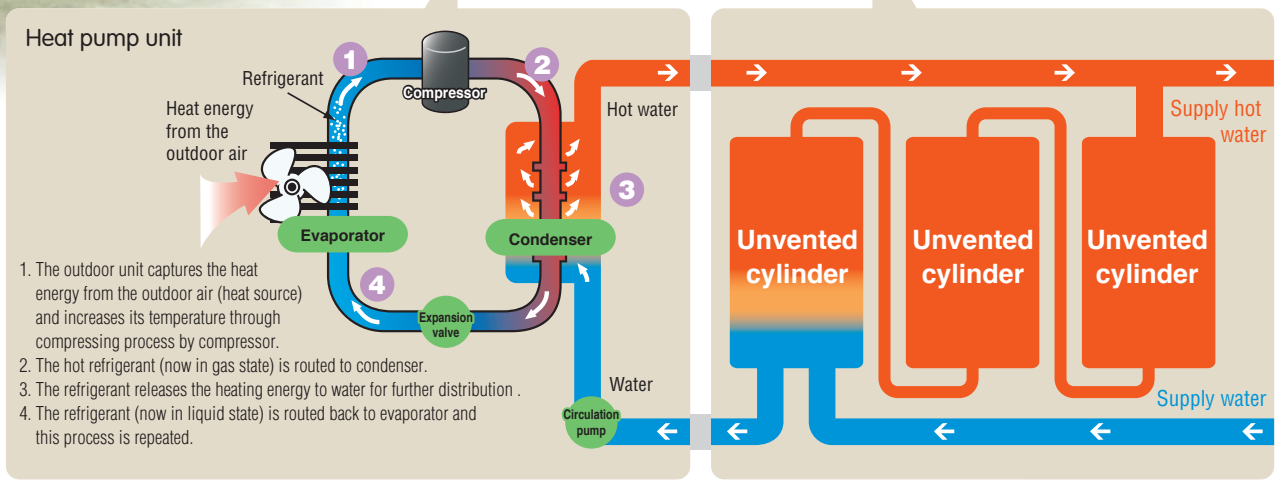
Heat energy is absorbed from the outside air when it passes through the outdoor unit; the energy is transported to the indoor unit in the refrigerant [in this case $CO_2$] within the piping system. This eliminates the need to bore holes or bury coils of pipes in the ground as used in conventional ground source systems.

## What is hot water supply by Heat Pump technology system ?




Recovering heat of the air






1. The outdoor unit captures the heat energy from the outdoor air (heat source) and increases its temperature through compressing process by compressor.
2. The hot refrigerant (now in gas state) is routed to condenser.
3. The refrigerant releases the heating energy to water for further distribution .
4. The refrigerant (now in liquid state) is routed back to evaporator and this process is repeated.

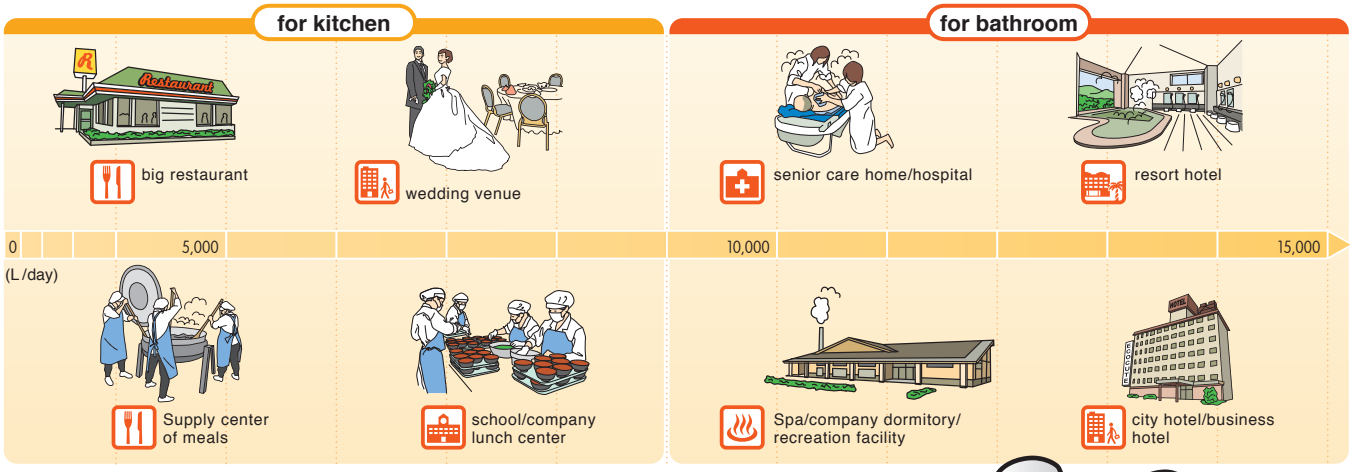
## Offering efficient energy saving is the greatest merit

Typically less than 1kW of output heat energy can be produced by conventional oil or gas boilers.
Heat pump technology is capable of producing up to 4.3kW of heat energy from 1kW of energy input making the system 4.3 times more efficient than traditional means.
Furthermore using natural refrigerant can provide comprehensive solution for realization of low-carbon society.

**Technology for Eco**

1. Dramatically reducing power consumption
2. Increasing Low Carbon initiative
3. GWP(Global Warming Potential): 1
   (R410 refrigerant:2090)
4. ODP(Ozone Depletion Potential): zero

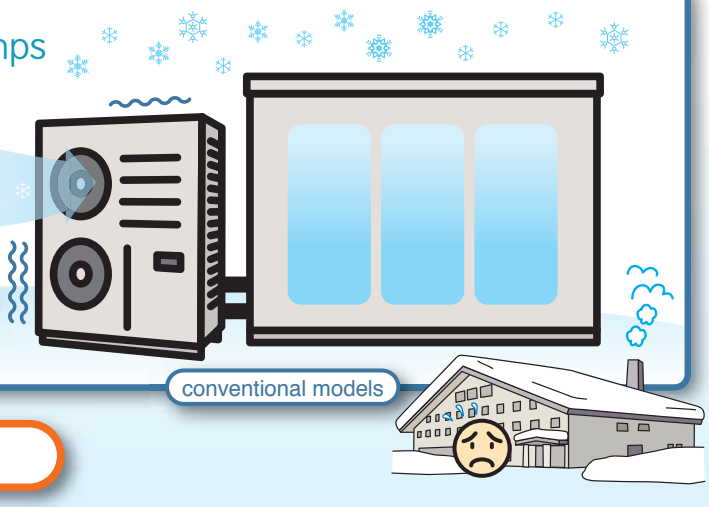
## ~Recommendable usage or customer~




# Transferring the heat to water and supplying hot water

### Conventional air to water heat pumps have performance issues to solve

In the operation under low outdoor temperature, heating capacity and heating efficiency decrease significantly.



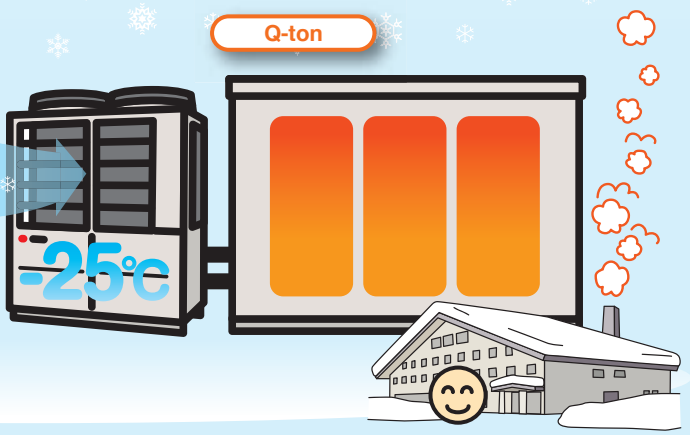

### Our development concept

Keeping high capacity and high efficiency in cold conditions

## Q-ton Air to Water is born

### Overwhelming high performance and high efficiency

- Supplying 90°C hot water at ambient temperatures down to -25°C
- Achieving the industry's top level COP "4.3"(in intermediate season)



# Q-ton's unique advantages

Advantage 1

## Overwhelming high capacity and high efficiency

**High Performance**

**-25°C** under extreme low outdoor temperature → **90°C** hot water supply

**-7°C** down to -7°C → **100%** can keep 100% capacity

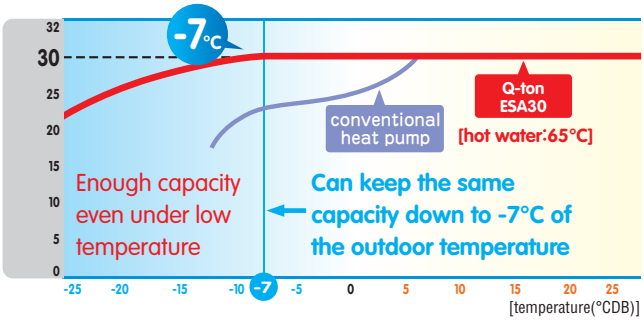
**Ecology**

COP : **4.3!** the industry's top level

COP = Capacity (kW) / Power consumption (kW)

The first introduction of 30kW inverter type, Achieving the industry's top level COP4.3. Keeping high efficiency and saving energy operation throughout the year.

[heating capacity (kW)]



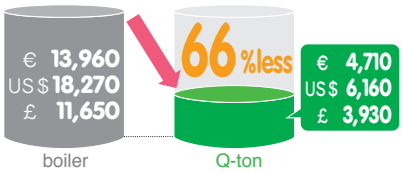
Activation of Q-ton in the extreme cold region.

### Advanced energy saving operation and low running cost

High efficiency heat pump water heaters can save running cost compared with traditional oil or gas boilers.

**Annual running cost** — **reduced amount**

€ 9,250
US$ 12,110
£ 7,720

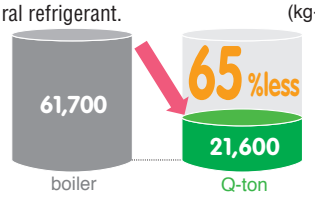



### Giving consideration to global environment by use of $CO_2$ refrigerant

High efficiency can minimize $CO_2$ emission.
Using One-GWP & zero-ODP natural refrigerant.

**Annual $CO_2$ emission amount** — **reduced amount** **40 t**

(kg-$CO_2$)




[Calculation conditions]
① Operation conditions : Senior care home/resident : 50 persons, purpose of use:bath, shower, wash stand (8000L/day, 60°C conversion)
② System : ■Q-ton 30kW, tank 3000L (10hrs/night + 10hrs/daytime)
●Heavy oil boiler:110kW
③ Price rate : ■Q-ton/electric rate daytime:€0.12, us$0.16, £0.10/kWh, night:€0.06, us$0.08, £0.05/kWh
●Boiler/heavy oil rate:€0.61, us$0.80, £0.51/L
④ $CO_2$ emission amount : ■Q-ton/electric: 0.423-$CO_2$/kWh
●Boiler/heavy oil: 2.71kW-$CO_2$/L
(€1=¥106 us$1=¥81 £1=¥127)

## Reason for high efficiency

### ● Scroll + rotary compressor

**Two-stage compressor**
By combination of two systems, high efficiency has been achieved in all operation conditions.

The first in the world

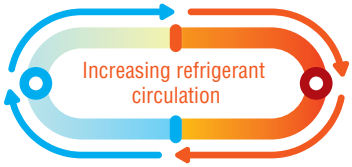
**Scroll system advanced at high pressure ratio**

×

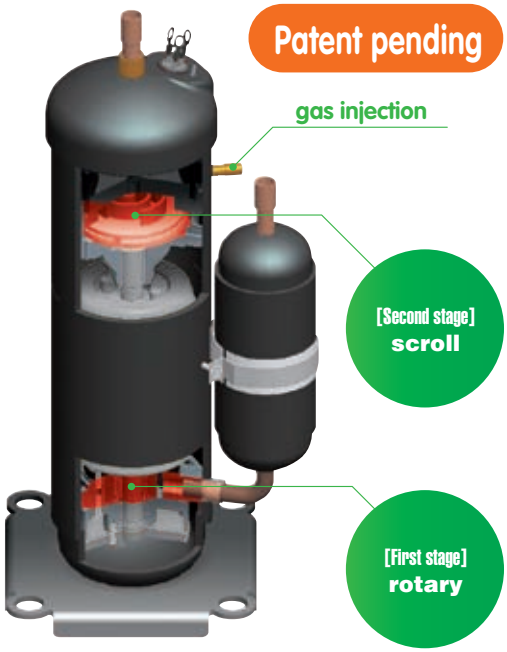
**Rotary system advanced at low pressure ratio**

### ● Intermediate pressure gas injection configuration

By increasing refrigerant circulation, high efficiency in low temperature can be achieved.




**Patent pending**

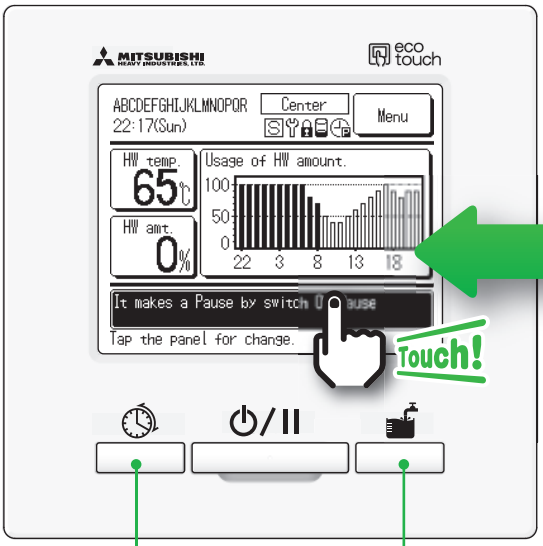


Advantage

# 2 Easy operation

Advanced touch screen panel with full dot Liquid Crystal display

eco touch REMOTE CONTROL




### User friendly

- LCD panel with light tap operation introduced as the industry's first
- Simple interface with only three buttons

### High level of visibility

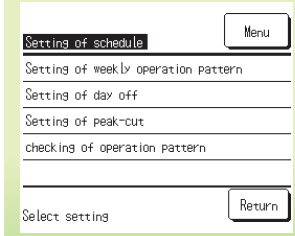
- Big LCD with 3.8 inch full dot display
- Back light function

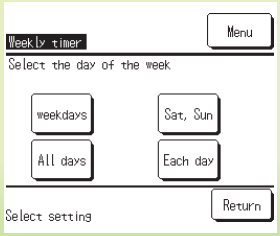
**You can check transition of hot water storage amount at a glance.**

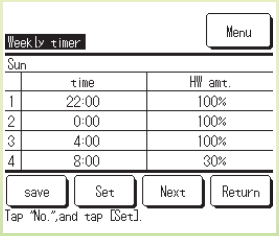
**RC-Q1E**

eco touch

**Schedule setting**

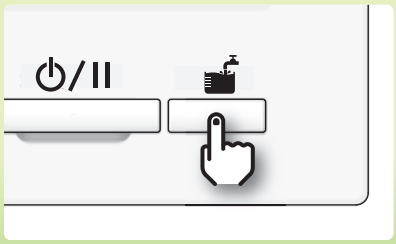



Setting of schedule such as weekly operation pattern , day off (for a Maximum one year) and peak-cut timer can be set easily.

**operation to fill up**




Irrespective of any setting operation, this operation will keep on filling up hot water in a tank (100%).

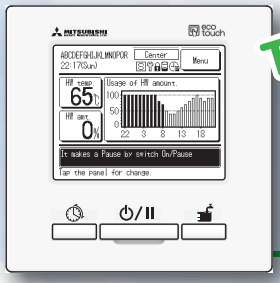
Advantage

# 3 Q-ton can be connected up to 16 units.

**Max connection : 16 units with only one remote control.**

As up to 480 kW capacity is possible by connecting 16 units of 30kW capacity, you can get enough hot water supply for any requirements.
In case of the same operation of all units, you can control the system with only one remote control.

# Hot water supply system

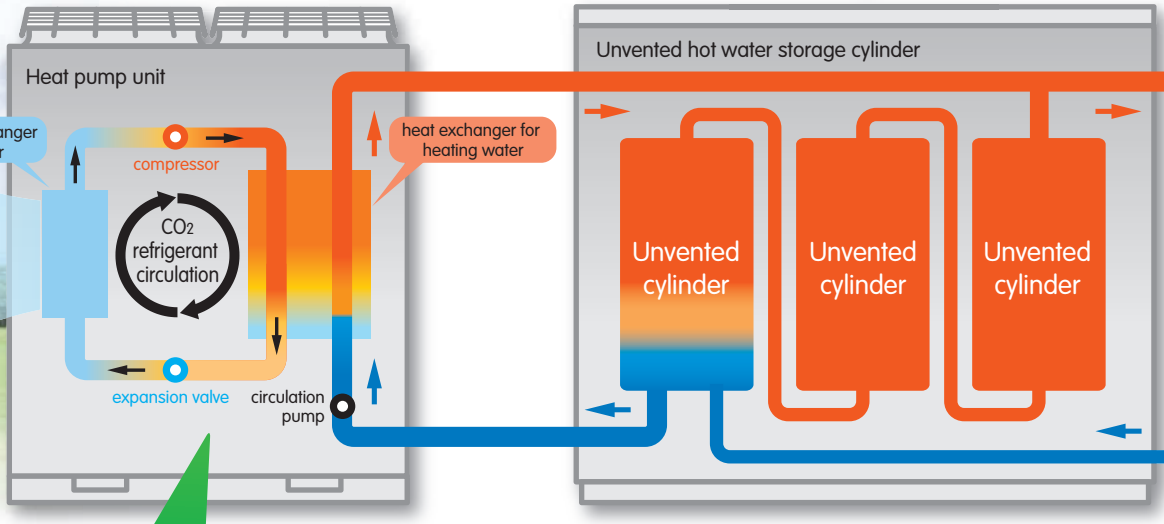


Touch!

## Ecology and comfortable hot water supply system

Starting an operation by a simple tap on button

eco touch
REMOTE CONTROL




Recovering heat energy from the air

The world's first two-stage compressor
Scroll + Rotary compressor
**High efficiency operation**

Water supply

### System configuration guide

| Hot water amount | Place | Recommendable system configuration sample |
|---|---|---|
| 3,000 L/day | Big restaurant | eco touch REMOTE CONTROL × 1unit / Heat source equipment × 1unit / Unvented cylinder 3,000L × 1 unit |
| 4,000 L/day | Supply center of meal | eco touch REMOTE CONTROL × 1 / Heat source equipment × 1 / 2,000L × 2 |
| 5,000 L/day | Wedding venue | eco touch REMOTE CONTROL × 1 / Heat source equipment × 1 / 2,000L × 1, 3,000L × 1 |
| 6,000 L/day | School/company lunch center | eco touch REMOTE CONTROL × 1 / Heat source equipment × 1 / 3,000L × 2 |

## TOTAL ENERGY SOLUTION

### Present the best solution

1. Select the best system configuration
2. Saving energy
3. Reducing $CO_2$ emission

**1. Research**
Listening to user's requirements in detail

**2 .Measurement and diagnosis**
Checking installation place and conditions correctly

**3. Plan and checking**
Make the plan for hot water supply

**High efficiency heat pump equipment**

Q-ton ESA30E

ECO Turbo ETW

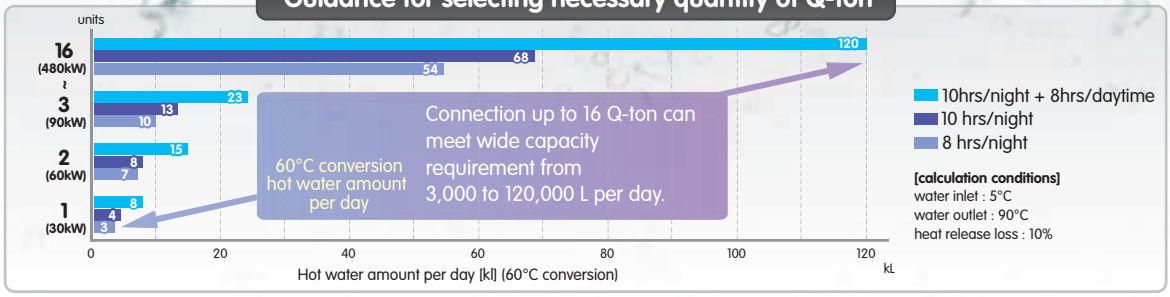
**4. Present the plan to the user**
Present the best total optimization plan to the user

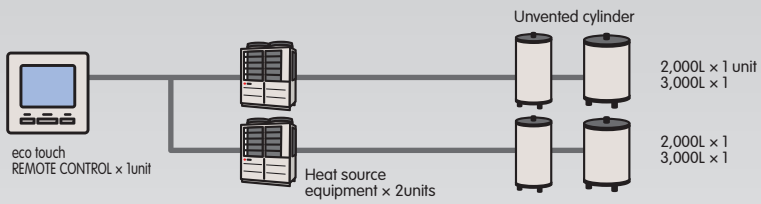
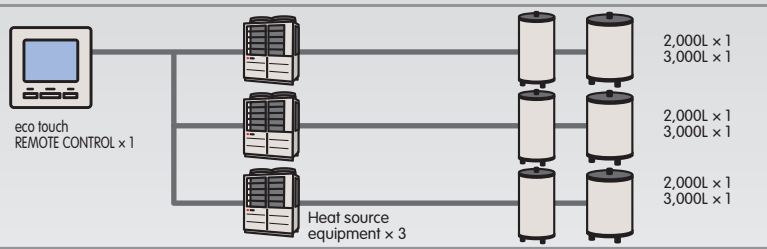
**5. Design and construction**
Planning to meet user's requirement with reliable design and construction for hot water supply

**6. After-sale services**
Present various service menu for regular maintenance

## Hot water supply

### Guidance for selecting necessary quantity of Q-ton




| Hot water amount | Place | Recommendable system configuration sample |
|---|---|---|
| 10,000 L/day | Hospital, senior care home, company dormitory, recreation facility |   |
| 15,000 L/day | spa/hotel |   |

# Installation samples in Japan

Osaka Prefecture
Osaka City
**01**

## Adult Day Care Centers

Seiseikai Medical Corporation
Yakata Tower for the Elderly

**Yakata has comfortable bathing facilities for day-service users. As a precaution, a back-up system is equipped to provide hot water at all times.**

### Annual running costs have been reduced by 66%.

Compared to combustion-base water heaters (boilers), this system can reduce running costs by approximately 66% per year.

### Two advantages of introducing this product.

Q-ton works with both a sealed tank and an open tank.
You can select the best system for your usage environment even when you need to change the design urgently.
By systematizing the system with one thermal source, we make back-up operation possible so that day-service users will not be inconvenienced.

Osaka Prefecture
Suita City
**02**

## Intensive Care Home for the Elderly

Rokushinkai Social Welfare Corporation
Rikyu Senriyama Welfare Facility Complex

**Rikyu Senriyama takes advantage of an all-electric system including hot-water supply and air conditioning. A 24-hour remote monitoring system provides them with peace of mind.**

### We offer proposals from the comprehensive viewpoint of energy-saving, efficiency and usability, including air conditioning.

Taking energy-saving, efficiency and usability into consideration, we offered a proposal, including for air conditioning. A heat pump was selected to supply hot water to reflect our consideration for the global environment and running costs. This institution expects to use 16,000 l of hot water per day for bathrooms, washrooms, the kitchen and other areas. With the Eco Touch remote control, you can easily set the amount of hot water to use and to reserve. This system is an effective way to save energy.
Also, by adopting a 24-hour remote monitoring system, they have been using the system with peace of mind.

Hyogo Prefecture
**03**

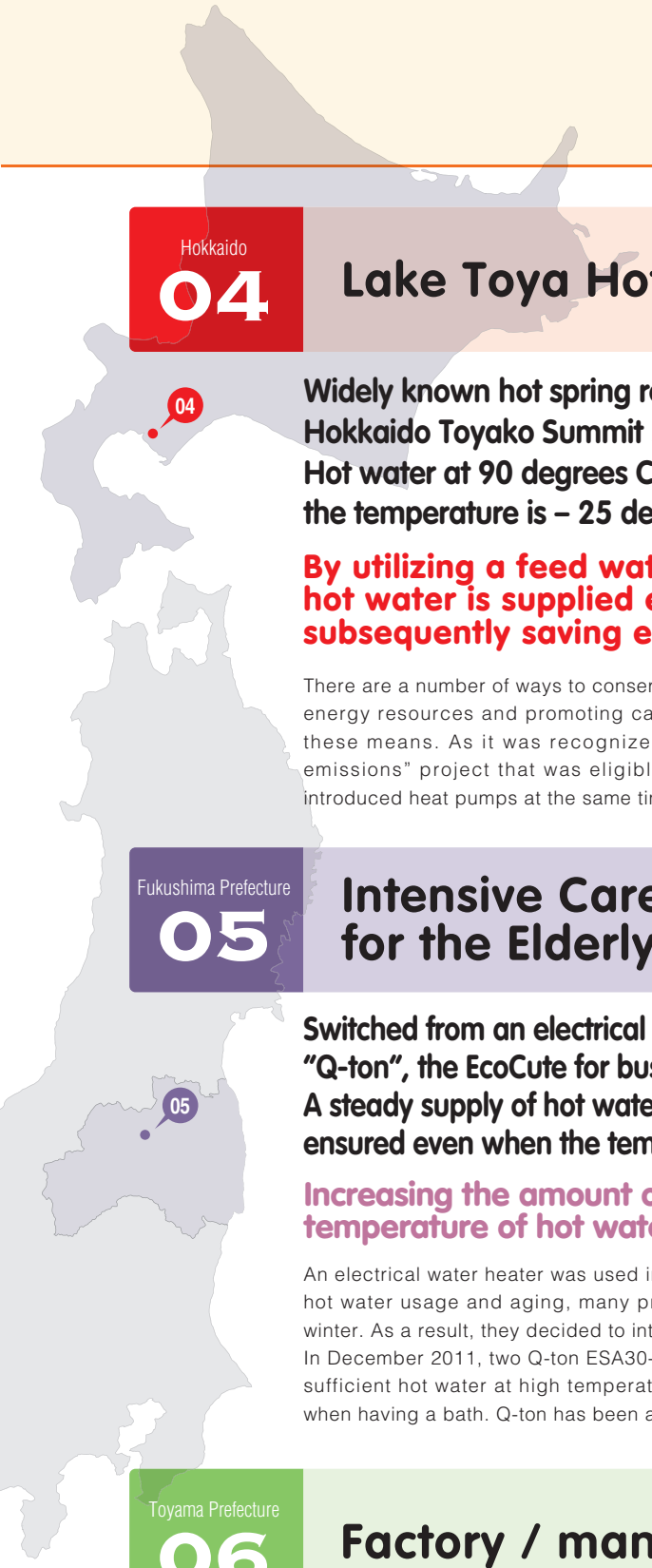
## Intensive Care Home for the Elderly

Jesus Band Social Welfare Corporation
Small-scale Intensive Care Home for the Elderly
Shin-ai Kumochi Home

**Q-ton plays an active role in the all-electric facility. Plenty of hot water and satisfaction with the Eco Touch remote control.**

### One Q-ton unit can supply all the hot water required.

Considering the global environment and the safety of residents, this institution introduced an all-electric system and adopted EcoCute for business purposes as a thermal source for heating water.
Hot water supplied by Q-ton is used in bathrooms and showers on each floor and on the ground floor for washing dishes in the kitchen. In the small-scale Intensive Care Home for the Elderly where up to 29 seniors live, one unit of Q-ton can supply all the hot water. The staff are happy with the system because it provides a stable source of hot water, saves energy, and is safe and easy to maintain.




Hokkaido
## 04 Lake Toya Hot Spring

- Hokkai Hotel
- Hotel Grand Toya
- Toya Kanko Hotel
- Toya Sansui Hotel

**Widely known hot spring resort where the G8 Hokkaido Toyako Summit 2008 was held. Hot water at 90 degrees C is available even when the temperature is – 25 degrees C.**

**By utilizing a feed water heating method, hot water is supplied efficiently, subsequently saving energy.**

There are a number of ways to conserve the environment including introducing new energy resources and promoting carbon offsets. Introducing a heat pump is of these means. As it was recognized as a "Village working to reduce carbon emissions" project that was eligible for subsidies from Hokkaido, four hotels introduced heat pumps at the same time.

Fukushima Prefecture
## 05 Intensive Care Home for the Elderly

Inawashiro Fukushikai Social Welfare Corporation
Inawashiro Home

**Switched from an electrical water heater to "Q-ton", the EcoCute for business purposes. A steady supply of hot water at 80 degrees C is ensured even when the temperature is -15 degrees C.**

**Increasing the amount of hot water required and reducing the temperature of hot water during winter time is now no longer a problem.**

An electrical water heater was used in the day service building from the time it was built, but due to the increase in hot water usage and aging, many problems developed including the temperature of hot water dropping during winter. As a result, they decided to introduce Q-ton.
In December 2011, two Q-ton ESA30-25 units and an MHQT8000KM open tank were installed. The system provided sufficient hot water at high temperatures, and users of day services subsequently could enjoy more satisfaction when having a bath. Q-ton has been adopted for a new living quarters that is scheduled to open soon.

Toyama Prefecture
## 06 Factory / manufacturing facility

NEC Toppan
Circuit Solutions, Inc.

**Highly efficient when heating feed water. Saving energy by using Q-ton and the existing boiler side by side.**

- **Steady performance in cold weather regions**
- **Defrosting function at low temperatures/high humidity**
- **Countermeasure against skyrocketing price of crude oil**

In the past, this company used heavy oil as a fuel to generate steam in a boiler and using the steam to heat the dry furnace and chemicals as well as for air conditioning. The amount of heat per unit price is greater when using a heat pump when taking the rising price of crude oil into account. Also, a heat pump emits less carbon dioxide. These were the decisive factors.

# Specifications and dimensions

## SPECIFICATIONS

| Item | | Model | ESA30E-25 |
|---|---|---|---|
| Power supply | | | 3-phase 380V ±5%, 400V ±5%, 415V ±5% 50Hz |
| Operation to top up (In intermediate season)*1 | Heating capacity | kW | 30 |
| | Water amount | Liter/min | 8.97 |
| | Power consumption | kW | 6.98 |
| | COP | – | 4.3 |
| Operation to top up (In cold region)*2 | Heating capacity | kW | 30 |
| | Water amount | Liter/min | 5.06 |
| | Power consumption | kW | 10.73 |
| | COP | – | 2.8 |
| Operating sound*3 | | dB(A) | 58 |
| Outside dimension | Height | mm | 1,690 |
| | Width | mm | 1,350 |
| | Depth | mm | 720 + 35 (Water pipe connection) |
| Curent | Max | A | 21 |
| | Starting | A | 5 |
| Unit weight | | kg | 375 (During operation 385) |
| Color | | | Stucco white (4.2Y7.5/1.1 approx.) |
| Compressor | Type × Pcs | | Hermetic inverter compressor × 1 |
| | Nominal output | kW | 6.4 |
| Refrigerant | Type | | R744 ($CO_2$) |
| | Charged amount | kg | 8.5 |
| Refrigerant oil | Type | | MA68 |
| | Charged volume | cc | 1200 |
| Crankcase heater | | W | 20 |
| Anti-freezing heater | for water pipe | W | 48 × 3 |
| | for drain pan | W | 40 × 2 |
| | for drain hose | W | 40 × 2 + 48 |
| Heat exchanger, Air side | | | Copper pipe straight fin type |
| Heat exchanger, Water side(Gas cooler) | | | Copper pipe coil type |
| Fan | Type | | Axial flow type (direct coupled motor) × 2 |
| | Output × Pcs | W | 386 × 2 |
| | Air volume | $m^3$/min | 260 |
| Water pump | Type × output | | Non-self-suction spiral type inverter pump × 100W |
| | Materials contacting to water | | Bronze, SCS13 |
| | Actual pump head | m (kPa) | 5m (49kPa) @17Liter/min |
| Usage temp range | Outdoor air temp | °C | –25 to +43 |
| | Feed water inlet temp | °C | 5-63 |
| | Hot water outlet temp | °C | 60-90 |
| Water pressure range | | kPa | 500 or lower |
| Defrost | | | Hot gas type |
| Vibration and sound proofing devices | | | Compressor: placed on anti-vibration rubber and wrapped with sound insulation |
| Protection devices | | | High pressure switch, over current protection, power transistor overheat protection and anomalous high pressure protection |
| Pipe size | Feed water inlet | | Rc3/4 (Copper 20A) |
| | Hot water outlet | | Rc3/4 (Copper 20A) |
| | Drain water outlet | | Rc3/4 (Copper 20A) |
| Electric wiring | Earth leakage breaker | | 30A, 30mA, 0.1sec |
| | Power cable size | | □14 × 4 (Length 40m) |
| | Moulded-case circuit breaker | | Rated corrent: 30A, switch capacity: 30A |
| | Grounding wire size | | M6 |
| | Remote controller wire size | | 0.3$mm^2$ × 2cores shielding wire (MVVS) |
| Design pressure | | MPa | High pressure: 14.0, Low pressure: 8.5 |
| IP code | | | IP24 |

(Note)

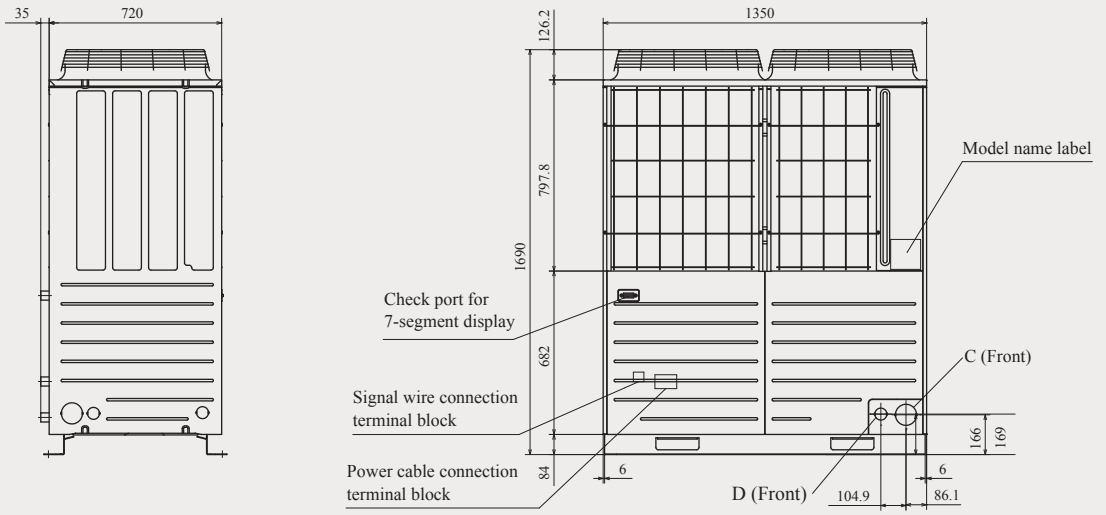
1. Performance of operation to top up in intermediate season shows the capacity measured under the conditions that outdoor air temp is 16°C DB/12°C WB, water inlet temp is 17°C and hot water outlet temp is 65°C.
2. Performance of operation to top up in cold region shows the capacity measured under the conditions that outdoor air temp is –7°C DB/–8°C WB, water inlet temp is 5°C and hot water outlet temp is 90°C excluding heater for anti-freezing water (345W).
3. Operating sound shows a value measured at 1m in front of the unit and 1m above the floor in anechoic room where the sound is resonated a little. Accordingly if the unit is installed on actual site, it is normal that the measured sound there is higher than the value shown above, because it is influenced by surrounding noise and echo in the room.
4. The actual hot water outlet temp may vary ±3°C from target temp according to the change of outdoor air temp and water inlet temp. And then if feed water inlet temp is 30°C or higher and outdoor air temp is 25°C or higher, hot water outlet temp may be controlled not to increase too high.
5. Please use the clean water. The water quality should follow a guideline of JRA-GL. 02:1994.
   If the water quality is out of the standard, it may cause troubles such as scale buildup and/or corrosion.
6. These articles mentioned above may vary without any notice according to the development status.

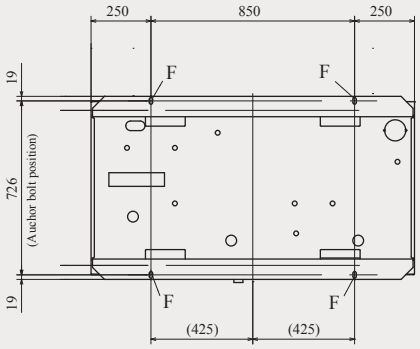
Fixing heat pump unit

| Anchor bolt | M10 × 4 |
|---|---|
| According to the installation conditions, please take a measure to prevent from falling, cross wind and heavy snow. | |

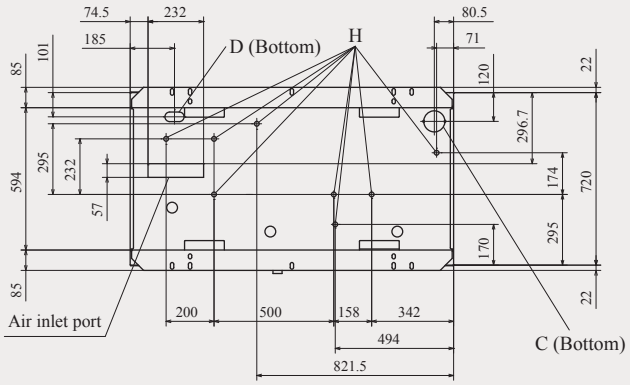
# Dimensions

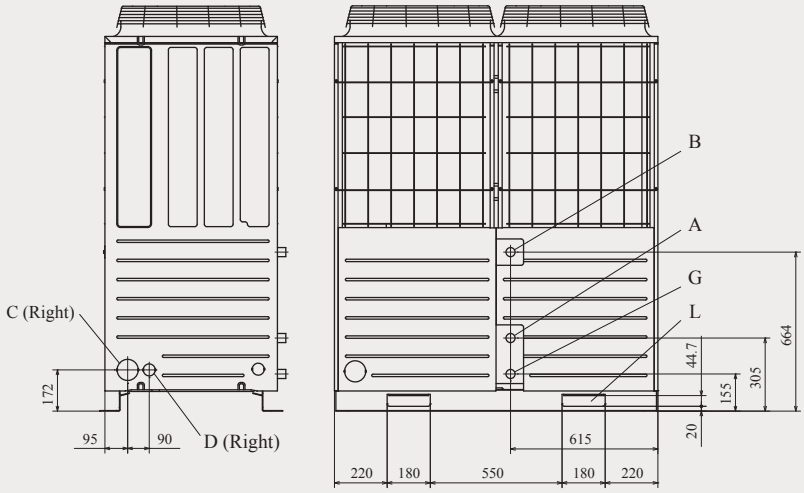
## Model : ESA30E




For dimension of anchor bolt hole



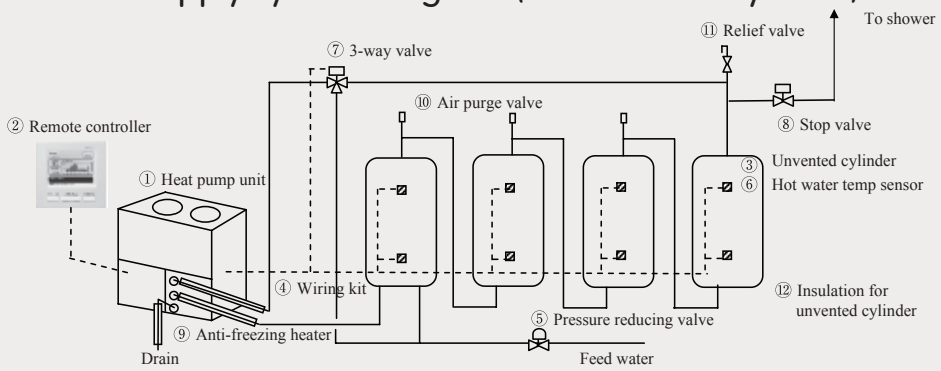




| Symbol | Contents | |
|---|---|---|
| A | Feed water inlet port | RC3/4 (Copper tube 20A) |
| B | Hot water outlet port | RC3/4 (Copper tube 20A) |
| C | Heat pump unit-Tank unit connecting wire outlet port | φ 88 (or φ100) |
| D | Power cable inlet port | φ 50 (right, front)<br>Long hole 40x80 (bottom) |
| F | Anchor bolt hole | M10 × 4pcs |
| G | Drain water pipe outlet port | RC3/4 (Copper tube 20A) |
| H | Drain hole | φ 20 × 8 |
| L | Hole for carrying in or hanging | 180 × 44.7 |

Note
(1) Be sure to fix the unit with anchor bolts
(2) Be sure to keep space above the unit at least 2m
(3) the connection of water pipes (Feed water inlet, Hot water outlet, Drain water outlet) should be done on site locally.
(4) The holes for power cable inlet, and connection wire outlet from heat pump unit to tank unit are half-blanked.
Therefore please punch out the hole by cutting the residual portion and use it.
(5) For fixing the unit, the hole (Symbol F) for anchor bolts (M10 x 10) can be used.
(6) In heavy snow region, please take following measures in order for the air inlet/outlet port and the bottom part of unit not to be covered with snow
① Place the unit on the rack in order to make the bottom of unit higher than the snow surface.
② Install a snow prevention hood (locally prepared according to the drawing provided by MHI) on the outlet port of the unit.
③ Install the unit at the space under the eaves or the snow prevention roof (locally prepared)
(7) If ambient temp becomes below 0ºC, it may cause break of water pipes and damage on the unit due to freezing
Be sure to apply anti-freezing heater to feed water piping , hot water piping and drain water piping in order to prevent from freezing.
(8) Be sure to keep enough service spaces of more than 800mm in front of the unit service panel for easy inspection of the unit and replacement of components.
When piping work is done, be sure not to interfere the pipes with the unit service space.
If the service space cannot be kept, please install the piping below the unit by placing the unit on the rack. (refer to following sample)

# Installation work

## 1. Standard hot water supply system diagram (for unvented cylinder)




**Component list of hot water supply system (for unvented cylinder)**

| | Part name | Model | General description |
|---|---|---|---|
| ① | Heat pump unit | ESA30E-25 | For outdoor air temp -25°C |
| ② | Remote controller for heat pump water heater (Optional part) | RC-Q1E | For setting hot water amount and setting hot water temp. |
| ③ | Unvented cylinder (Locally procured) | — | Refer to the specifications of unvented cylinder mentioned on next page. |
| ④ | Wiring kit for unvented cylinder (Optional part) | MTH-Q1E (20m length of wire) or MTH-Q2E (10m length of wire) | For connecting heat pump unit with unvented cylinder<br>• Connect to the water temp sensor of unvented cylinder<br>• Connect to the 3-way valve for switching to anti-freezing circuit and control it |
| ⑤ | Pressure reducing valve (Locally procured ) | — | Setting pressure≦400kPa<br>Connecting pipe size≧32A<br>If the feed water pressure exceeds 400kPa, be sure to mount it |
| ⑥ | Hot water temp sensor (Optional part) | MTH-Q3E | Mounting or pasting on the unvented cylinder for detecting hot water temp in the cylinder. 1.25m length x 9 |
| ⑦ | 3-way valve (Optional part) | MTH-Q4E | For switching to anti-freezing circuit |
| ⑧ | Stop valve of hot water supply (Optional part) | MTH-Q5E | If the multiple heat pump water heaters are connected, it is necessary to use at the hot water supply line. |
| ⑨ | Anti-freezing water heater (Locally procured) | — | When outdoor air temp becomes below 0°C, be sure to install this heater on the water pipe (10W/m) |
| ⑩ | Air purge valve (Locally procured) | — | For purging the air in the hot water system which is generated during heating up the water in the unit or is mixed in the system when feeding water. Each valve is required for each cylinder. |
| ⑪ | Relief valve (Locally procured) | — | For preventing from increasing pressure in the system during heating up the water.<br>Working pressure: 450±30kPa or lower. |
| ⑫ | Insulation (Locally procured) | — | Heat resistance ≧ 120°C<br>• For the cylinder shell: 50mm or thicker glass wool whose density is 16kg/m$^3$.<br>• For the cylinder end plate: 50mm or thicker glass wool whose density is 24kg/m$^3$.<br>• For the water piping: 30mm or thicker glass wool whose density is 48kg/m$^3$. |

## 2. Specifications of unvented hot water storage cylinder for connecting to ESA30E

Please arrange and procure a new unvented cylinder with following specifications for connecting to ESA30E.

* If connecting ESA30 to the existing cylinder, the hot water temp and amount in the cylinder cannot be detected correctly. In such case, please consult with our distributor.
  In some case, preliminary survey on site may be required before installation

Specifications of unvented cylinder

• For commercial use
  The cylinder is installed indoors, not outdoors

• It should be unvented hot water storage cylinder, not open tank

• The minimum capacity is 500liter. If increasing capacity, please use bigger size cylinder or several cylinders in parallel.

• The maximum capacity is 4000liter. (only as a guide)
  The cylinder capacity may vary according to feed water inlet temp, hot water outlet temp and operation hours in the night.
  25837 x Operation hour in the night/ (Hot water outlet temp- feed water inlet temp) =available hot water supply volume (Liter). However, there is dead volume, where the cold water is always filled in, at the bottom of cylinder to which the feed water line is connected.
  Therefore please select the cylinder volume in consideration of available hot water supply volume and dead volume.

• Design pressure
  Design pressure is 0.5MPa or higher.
  The design pressure of ESA30E is 0.5MPa. Even if the design pressure of the cylinder is 0.5MPa or higher, the maximum water pressure applied to the cylinder actually shall be less than 0.5MPa. And please decide the usage pressure in consideration of allowance and setting value of relief valve.
  Even if the actual pressure applied to the cylinder is 0.5MPa, the cylinder can be used, but the minimum pressure shall be 0.1 to 0.2MPa or higher. If the pressure becomes lower than the minimum pressure, water volume becomes decreasing.

• Pipe connection port

Cylinder has one or more pipe connection ports at the top. The size of port shall be 32A or bigger.
If it is smaller than 32A, it is difficult to detect the hot water temp and hot water amount in the cylinder properly. And when discharging the hot water from the cylinder, the outlet flow volume may be restricted.
Cylinder has 2 or more pipe connection ports at the bottom. The size of one port shall be 32A and the other port shall be 20A.

• Specifications of inner cylinder

In order to ensure the temp boundary layer as minimum as possible when hot water and feed water flow into the cylinder, the cylinder shall have buffer plates built-in.

• Material

SUS444 or SUS316 (with consideration for stress corrosion cracking resistance)
If using the other material than the specified one, hot water temp and hot water amount in the cylinder may not be detected correctly. Please consult with our distributor.

• Heat resisting temperature

90°C
The maximum hot water outlet temp of ESA30E is 90°C. If the heat resisting temp of the cylinder is lower than 90°C. Be sure to reduce the hot water outlet setting temp in order to meet the specifications of the cylinder.
If using the cylinder at the higher water outlet temp than the heat resisting temp of the cylinder, it may have break of the cylinder or leak age of hot water.

• Applying hot water temp sensors on the cylinder

In order to judge the hot water temp and amount in the cylinder, the temp sensors shall be mounted or pasted on the cylinder.
If pasting the temp sensors, they shall be pasted with aluminum adhesive tape whose heat resisting temp is 90°C or higher.
If mounting the temp sensors, the insertion holes with ø7mm or bigger in size and 20mm or deeper in depth are required on the cylinder.
MHI's genuine temp sensor, MHT-Q3E (optional part), shall be used.
3 to 9 sets of temp sensors shall be applied to the cylinder.
In order to detect the hot water amount by 10% intervals, 9 sets of temp sensors shall be applied to the cylinder. If reducing the number of temp sensor, the hot water amount cannot be detected properly.
Ex) In case of applying 3 sensors, heat pump unit can detect only 20%, 60% and 100% of HW amount. (Please refer to following table)
Therefore, even though 80% of HW amount is set with schedule setting, the HP unit cannot stop at storing 80% of HW amount and it still keeps on operating until storing 100% of HW amount.
And if 30% of HW amount is set for the operating to top up, HP unit cannot start operation to top up until HW amount decreases to 20%.
Accordingly, we recommend to apply 9 sensors to the cylinder for precise control.
The positions to apply the temp sensors on the cylinder are depended on the number of sensors and sensors should be applied to the designated positions on the cylinder.
According to the following table, please check the number of sensor and apply each sensor to the designated position of hot water amount % according to the sensor No.

The position to apply temp sensor according to the hot water amount %

Recommendable

| Number of sensors to apply | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sensor No. | 3pcs | 4pcs | 5pcs | 6pcs | 7pcs | 8pcs | 9pcs*1 |
| Tht-1 | 20% | 20% | 20% | 10% | 20% | 10% | 10% |
| Tht-2 | 60% | 50% | 40% | 30% | 30% | 20% | 20% |
| Tht-3 | 100%*2 | 75% | 60% | 40% | 40% | 30% | 30% |
| Tht-4 | | 100%*2 | 80% | 60% | 50% | 50% | 40% |
| Tht-5 | | | 100%*2 | 70% | 65% | 60% | 50% |
| Tht-6 | | | | 100%*2 | 80% | 70% | 60% |
| Tht-7 | | | | | 100%*2 | 80% | 70% |
| Tht-8 | | | | | | 100%*2 | 80% |
| Tht-9 | | | | | | | 100%*2 |

*1 Recommendable number of sensors is 9pcs.
If the number of sensors is less than 9pcs, the hot water amount cannot be detected correctly.
*2 The sensor which detects 100% of HW amount shall be applied to the position within the range of sensitive volume with consideration of dead volume which is 10% of total volume of cylinder.

• Insulation

Insulation must be required in order to keep hot water temp stored in the cylinder.

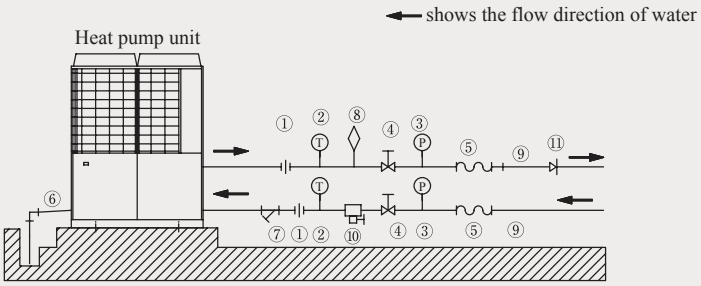
- Shell
  Material: Glass wool
  Density: 16kg/m$^3$
  Thickness: 50mm or more
- End plate
  Material: Glass wool
  Density: 24kg/m$^3$
  Thickness: 50mm or more

• Carry in, Installation and Service & maintenance space

It depends on the installation manual of the cylinder procured.

# 3. Water piping work

### (1) Outline of water piping




Structure of water piping

(i) Key consideration for water piping

Please consider following point when designing and installing. (Description of ① – ⑪ in above figure)

| | |
|---|---|
| ① Union joint | Be sure to fit it in order to enable the unit replacement easily. |
| ② Thermometer | Be sure to equip it for capacity check and operation monitoring |
| ③ Water pressure gauge | You had better equip it for checking operation status. |
| ④ Valve | Be sure to fit it for servicing such as cleaning heat exchanger and/or replacing unit and etc. |
| ⑤ Flexible joint | Be sure to fit it for preventing from transmittance of vibration |
| ⑥ Drain piping | Be sure to make its descending slop as larger as possible and make the distance of its horizontal part as shorter as possible in order to prevent the drain water from freezing. Moreover, in cold region, be sure to take a measure for anti-freezing drain water by equipping drain heater or like that. |
| ⑦ Strainer | Be sure to fit a strainer (60 mesh or more) at the inlet port of the unit to avoid intrusion of foreign matter into the unit. |
| ⑧ Air purge valve | Be sure to equip it to the place where air may accumulate in order to purge air in the water pipe. |
| ⑨ Water piping | Water piping work shall be done by considering to purge air in the water pipe easily. Insulation work shall be done sufficiently. |
| ⑩ Drain valve | Be sure to equip it in order to drain off the water from the system at servicing. |
| ⑪ Check valve | Be sure to equip it in order to operate the multiple heat pump water heaters. |

(ii) Caution for corrosion

① Water quality

It is important to check in advance whether the feed water and hot water have good quality.

Be sure to use cyclic water and makeup water whose qualities are within the range of water quality criteria mentioned in Page 20.

② Foreign matter in water

If solid matter such as sand and small stone and/or floating suspended solid such as corrosion product exist in water, the heat-transfer surface of heat exchanger is directly attacked by water flow, and corrosion may be created locally.

In order to avoid such corrosion by these foreign matters, be sure to fit a cleanable strainer (60 mesh or higher) at the water inlet port of the unit to remove foreign matters.

③ Contact of different metal

Depending on the type of metal, if different metals contact directly, corrosion may be generated at contact part.

Refer to followings and in case of the combination of different metals to generate corrosion, take a measure not to generate corrosion by inserting a non-conductive material (non-metallic insulation flange and etc) between the metals or by other method

| | |
|---|---|
| The combination not to generate corrosion by contact of metals | ① Stainless steel (SUS304, SUS316) |
| | ② Bronze |
| | ③ Copper |

④ Others

1) Water pipe shall have no water leak and no air intrusion. Especially if air intrudes at suction side of pump, pump performance becomes decreasing and it may cause generation of noise

2) Be sure to take into consideration for water pipe not to freeze at stopping operation in winter

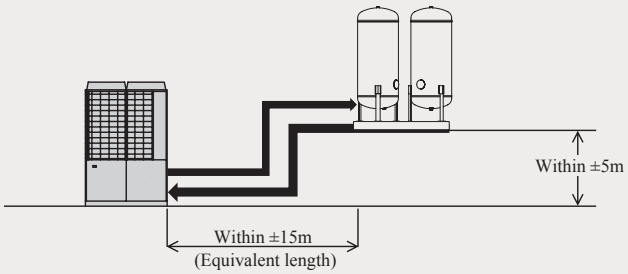
## Water piping work

- When doing piping work between the heat pump unit and the unvented cylinder, be sure not to interfere the service space of the heat pump unit. Regarding the service space, please refer to chapter 2

### (2) Limitation of piping length between the heat pump unit and the unvented cylinder

Be sure to install the heat pump unit and the unvented cylinder in the shortest piping length from the view point of saving energy. Piping length and height difference shall be within a following range.

Limitation of piping length




Between heat pump unit and unvented cilynder

i) Piping length: Within 15m (equivalent length for pipe size 20A)

ii) Height difference: Within ±5m

### (3) Drain piping work

- At a place where the drain water from the heat pump unit becomes a problem, please install drain piping by using drain elbow, drain grommet (locally prepared)
- The end of drain pipe shall be open the air.
- When draining from drain pipe of unvented cylinder, open the pressure relief valve (raise the lever), and after the end of drain, close the valve (let down the lever)

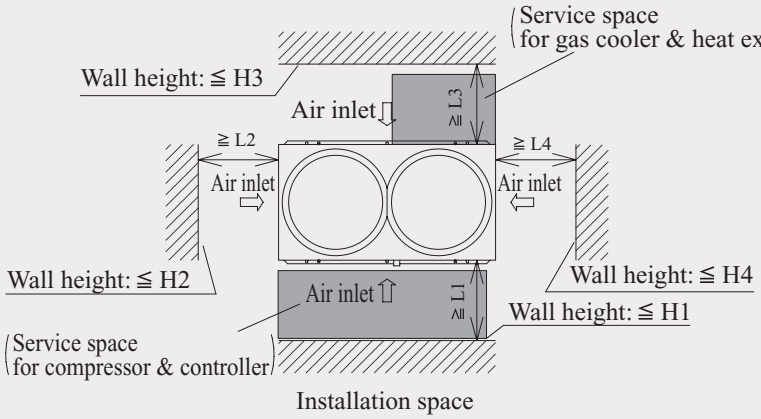
### (4) Water quality criteria

Makeup water and cyclic water shall be the water within the range of water quality criteria mentioned below.

If water quality is out of the range of criteria, it may cause a trouble such as scale adhesion and corrosion.

| Item | | | Cyclic water (60°C< ≦90°C) | Makeup water |
|---|---|---|---|---|
| Standard items | pH (25°C) | – | 7.0 – 8.0 | 7.0 – 8.0 |
| | Electric conductivity (25°C) | mS/m | ≦30 | ≦30 |
| | Chloride ion | mg$Cl^-$ /L | ≦30 | ≦30 |
| | Sulphate ion | mg$SO_3^{2-}$ /L | ≦30 | ≦30 |
| | Acid consumption (pH4.8) | mg$CaCO_3$/L | ≦50 | ≦50 |
| | Sulphide ion/Acid consumption | – | ≦0.5 | ≦0.5 |
| | Total hardness | mg$CaCO_3$/L | ≦70 | ≦70 |
| | Calcium hardness | mg$CaCO_3$/L | ≦50 | ≦50 |
| | Ionic silica | mg$SiO_2$/L | ≦20 | ≦20 |
| Reference items | Iron | mgFe/L | ≦0.1 | ≦0.3 |
| | Copper | mgCu/L | ≦0.1 | ≦0.1 |
| | Sulphide ion | mg$S^{2-}$/L | Not detected | Not detected |
| | Ammonium ion | mg$NH^{4+}$/L | ≦0.1 | ≦0.1 |
| | Residual chlorine | mgCl /L | ≦0.1 | ≦0.3 |
| | Free carbon | mg$CO_2$/L | ≦0.4 | ≦4.0 |
| | Stability index | | – | – |

# 4. Heat pump unit installation space (Service space)



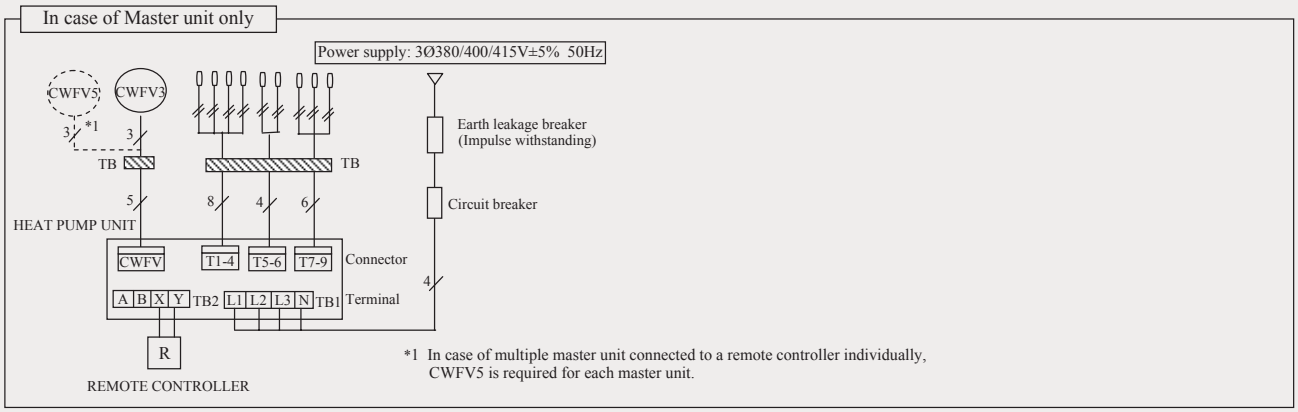

| Dimension \ Installation example | 1 | 2 |
|---|---|---|
| L1 | 800 | 800 |
| L2 | 10 | 10 |
| L3 | 800 | 800 |
| L4 | 100 | 500 |
| L5 | 100 | 500 |
| L6 | 100 | 500 |
| H1 | 500 | 1500 |
| H2 | No limit | No limit |
| H3 | 1000 | 1000 |
| H4 | No limit | No limit |

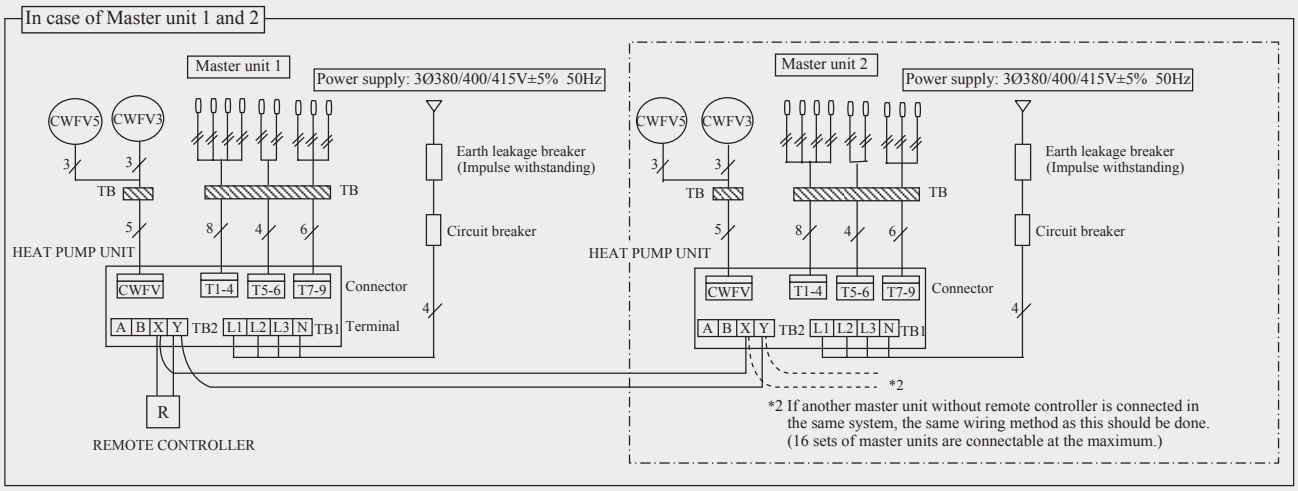
# 5. Electrical wiring work

Electrical installation work must be performed by an electrical installation service provider qualified by a power provider of the country. Electrical installation work must be executed according to the technical standards and other regulations applicable to electrical installations in the country.

**Please install an earth leakage breaker without fail.** The installation of an earth leakage breaker is compulsory in order to prevent electric shocks or fire accidents.
(Since this heat pump unit employs inverter control, please **use an impulse withstanding type one** to prevent the earth leakage breaker from false activation.+

### (1) Wiring system drawing



## (2) Connecting method of power cable

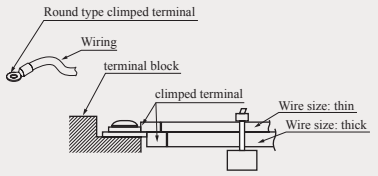
This heat pump unit corresponds to 3-phase 380V±5% (50Hz), 400V±5% (50Hz) and 415V±5% (50Hz). of power specifications. However for creating 200V±10% of power voltage for control line, it is necessary to change connection of wire on the terminal block (TB2) in the control box according to the supply power voltage to be used.

### (a) Method for leading out cables

- Cables can be led out through the front, right, left panel and bottom plate.
- In wiring on installation site, cut off a half-blank (Ø50 or elongate hole 40x80) cover for penetration of cables with nipper.
- In case of a collective drain piping, please use the hole to lead out cables or pipe other than the hole on bottom plate. If the hole on bottom plate is used, be careful to apply adequate seal in order not to leak drain.

### (b) Notabilia in connecting power cables

- Connect the grounding wire before connecting power cable. When connecting a grounding wire to a terminal block, use a grounding wire whose length is longer than the power cable so that it may not be subject to tension.
- Do not turn on power until installation work is completed. Turn off power to the unit before servicing the unit.
- Ensure that the unit is properly grounded.
- Power cables must always be connected to the power cable terminal block and clamped them outside the control box.
- In connecting to the power cable terminal block, use a round -type crimped terminal.
- If 2 cables connect to one terminal block, be sure to put the crimped terminals to back connection. And in such case please place a thin cable on the thick cable as shown in the right figure.
- Use specified wires in wiring, and fasten them securely in such a manner that the terminal blocks are not subject to external force.
- In tightening a screw of terminal block, be sure to use a correct-size screw driver. Tightening a screw of terminal block with excessive torque force may break the screw. For the tightening torque of terminals, refer to the table shown at right.
- When electrical installation work is completed, make sure that all electrical components in the control box have no loose connector coupling or no loose terminal connection.




| tightening torque (N·m) | | |
|---|---|---|
| M4 | Signal line terminal block | 0.68-0.82 |
| M6 | grounding wire | 2.50-3.00 |
| M12 | Power cable terminal block | 22.05-26.46 |

### (c) Heat pump unit power supply specifications: 3-phase 380V/400V/415V±5% 50Hz

| Cable size for power source ($mm^2$) | Wire length (m) | Earth leakage breaker (Grounding fault, overload, short circuit protection) | Earth wire | |
|---|---|---|---|---|
| | | | Size ($mm^2$) | Screw type |
| 14 | 35 | 30A, 100mA, 0.1sec or shorter | 14 | M6 |

### Please note

① Wiring procedure is determined by JEAC8001 (please adapt it to the regulations in effect in each country.)
② The wire length and cable size in above table show that within 2% of voltage drop. If the wire length exceeds the value shown in the above table, review the cable size according to the regulations of the country.
③ If the earth leakage breaker is exclusive for ground fault protection, the circuit breaker is required additionally. For selecting the circuit breaker, please refer to the technical manual or ask our distributor.

## (3) Connecting method of signal wire

- **The signal line is DC5V so that please do not connect single phase 220V/230V/240V of power cable to the signal line. In case to connect power cable, the fuse on the control PCB is blown.**

① Please check that power cable is not connected to the signal line.
② Before turning on power supply, be sure to check resistance on the terminal block of signal line. If the measured resistance is 100Ω or lower, power line may touch to signal line.

- Standard signal wire size is 0.75$mm^2$ x 2 cores shielding wire (MVVS)
- The both end of shielding wire shall be grounded.

| Length (m) | Wire size |
|---|---|
| 100≦ ＜200 | 0.5$mm^2$ x 2 cores shielding wire (MVVS) |
| 200≦ ＜300 | 0.75$mm^2$ x 2 cores shielding wire (MVVS) |
| 300≦ ＜400 | 1.25$mm^2$ x 2 cores shielding wire (MVVS) |
| 400≦ ＜600 | 2.0$mm^2$ x 2 cores shielding wire (MVVS) |

### Remote controller wiring

- Standard remote controller wire size is 0.3$mm^2$ x 2 cores shielding wire (MVVS)
- The both end of shielding wire shall be grounded.
- If using 100m or longer wire, please use the wire size shown in below table.